

AL.1.1537
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January 2002



Science 30
Grade 12 Diploma Examination

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January 2002

Science 30

Grade 12 Diploma Examination

Description

Time: This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 40 multiple-choice and 12 numerical-response questions of equal value, worth 65% of the examination
- 1 short-answer question and 2 long-answer questions, worth 35% of the examination

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A science data booklet is provided for your reference.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.*

Instructions

- You are expected to provide your own calculator. You may use any scientific calculator or a graphing calculator approved by Alberta Learning.
- You are expected to have cleared your calculator of all information that is stored in the programmable or parametric memory.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- When performing calculations, use the values of the constants provided in the data booklet. Do **not** use the values programmed in your calculator.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Learning.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

- A. science
- B. biology
- C. physics
- D. chemistry

Answer Sheet

☒ (B) (C) (D)

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.

(Record your **three-digit** answer in the numerical-response section on the answer sheet.)

$$\begin{aligned}\text{Average} &= (21.0 + 25.5 + 24.5)/3 \\ &= 23.666 \\ &= 23.7 \text{ (rounded to three digits)}\end{aligned}$$

Record 23.7 on the answer sheet →

2	3	.	7
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<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0	<input type="radio"/> 0
<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1	<input type="radio"/> 1
<input checked="" type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2	<input type="radio"/> 2
<input type="radio"/> 3	<input checked="" type="radio"/>	<input type="radio"/> 3	<input type="radio"/> 3
<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4	<input type="radio"/> 4
<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5	<input type="radio"/> 5
<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6	<input type="radio"/> 6
<input type="radio"/> 7	<input type="radio"/> 7	<input type="radio"/> 7	<input checked="" type="radio"/>
<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8	<input type="radio"/> 8
<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9	<input type="radio"/> 9

Correct-Order Question and Solution

When the following subjects are arranged in alphabetical order, the order is _____, _____, _____, and _____.

- 1 physics
- 2 biology
- 3 science
- 4 chemistry

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)


Answer: 2413

Record 2413 on the answer sheet →

2	4	1	3
•	•		
0	0	0	0
1	1	●	1
●	2	2	2
3	3	3	●
4	●	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Written Response

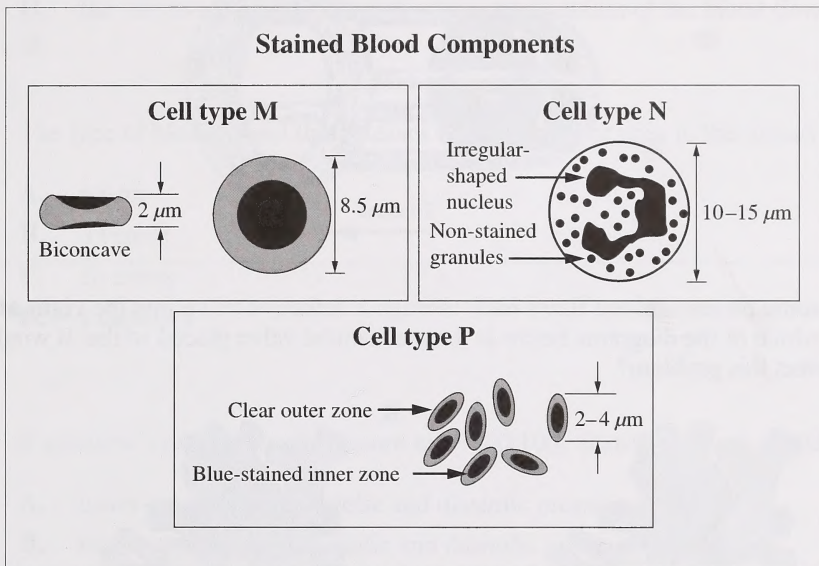
- Write your responses in the examination booklet as neatly as possible.
- For full marks, your responses must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your responses must be presented in a well-organized manner using complete sentences, correct units and correct significant digits, where appropriate.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and made explicit.



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Staff at a medical clinic are familiar with body systems and the technologies used to treat problems associated with them.

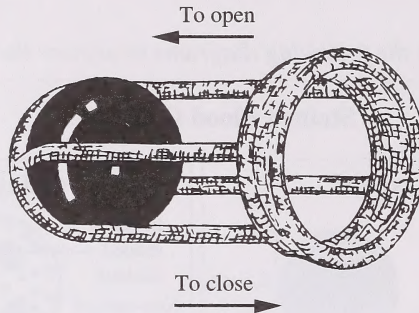
Use the following diagrams to answer the first question.



1. Cell types M, N, and P shown above represent, respectively,
 - A. a red blood cell, a white blood cell, and platelets
 - B. a red blood cell, a platelet, and white blood cells
 - C. a platelet, a red blood cell, and white blood cells
 - D. a platelet, a white blood cell, and red blood cells
2. Which of the following defence system components is **not** considered part of the body's first defence against infection?
 - A. Tears
 - B. Skin cells
 - C. Stomach acid
 - D. Helper T cells

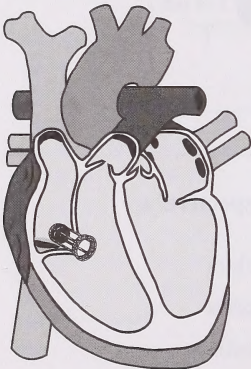
Use the following information to answer the next question.

A faulty heart valve allows blood to flow back into a previous chamber. This condition may be treated by replacing the faulty valve with a mechanical one.

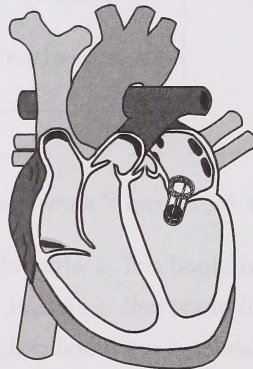


3. In some patients, blood flows back through a defective valve into the **right atrium**. In which of the diagrams below is the mechanical valve placed so that it would correct this problem?

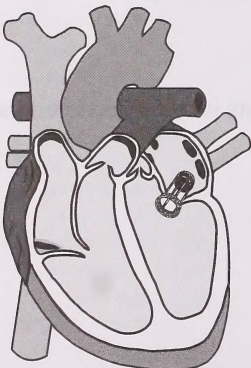
A.



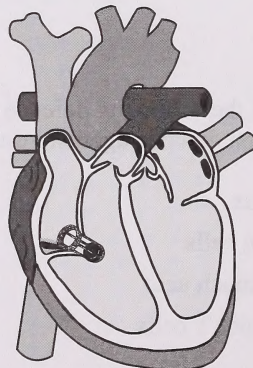
B.



C.



D.



4. The mechanisms that control blood flow in arteries are different than the mechanisms that control blood flow in veins. In arteries,
- A. there are no valves
 - B. the valves are attached to muscles
 - C. valves only exist in secondary vessels
 - D. the valves are positioned in the opposite direction of the blood flow in veins
5. The type of blood vessel that releases nutrients and oxygen to the tissues is called
- A. a vein
 - B. a venule
 - C. an artery
 - D. a capillary
6. If a patient's resting blood pressure was 160/100, then the patient would have
- A. lower-than-average systolic and diastolic pressure
 - B. higher-than-average systolic and diastolic pressure
 - C. higher-than-average systolic pressure and lower-than-average diastolic pressure
 - D. lower-than-average systolic pressure and higher-than-average diastolic pressure

Use the following information to answer the next question.

Disease-Fighting Mechanisms

- 1 Vaccines
- 2 Antibiotics
- 3 Antibodies
- 4 Gene therapy

Numerical Response

1. Match each of the mechanisms listed above with its description given below. Use each number only once.

Proteins that combine with specific antigens _____ (Record in the **first** column)
The replacement of defective alleles with normal alleles _____ (Record in the **second** column)
Weakened viruses that produce immunity _____ (Record in the **third** column)
Compounds developed to kill bacteria _____ (Record in the **fourth** column)

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

7. Foreign proteins in the blood stimulate an immune response. In which of the following rows is a type of white blood cell paired with its function?

Row	White Blood Cell	Function
A.	Macrophages	Ingest antigens
B.	B cells	Start immune response
C.	Helper T cells	Stop immune response
D.	Killer (cytotoxic) T cells	Produce antibodies

Use the following information to answer the next question.

Some Steps Involved in the Development of Immunity

- 1** Helper T cells stimulate B cells to produce antibodies.
- 2** Macrophages present antigens to T cells.
- 3** Memory T cells remain in the body, ready in case a familiar antigen enters the body at a later time.
- 4** Suppressor T cells turn off the immune response.

Numerical Response

- 2.** The steps above, arranged in the order in which they occur, are _____ , _____ , _____ , and _____ .
first **last**

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

Neurons



Nerve networks perform an important communication function in the body. Some events that occur in the transfer of a nerve impulse from an interneuron to a motor neuron are listed below.

- 1 An impulse moves along the motor neuron dendrite.
- 2 Cholinesterase breaks apart acetylcholine molecules.
- 3 An impulse moves along the interneuron axon.
- 4 An interneuron axon releases acetylcholine molecules into synapse; acetylcholine attaches to the membrane of the motor neuron dendrite.

Numerical Response

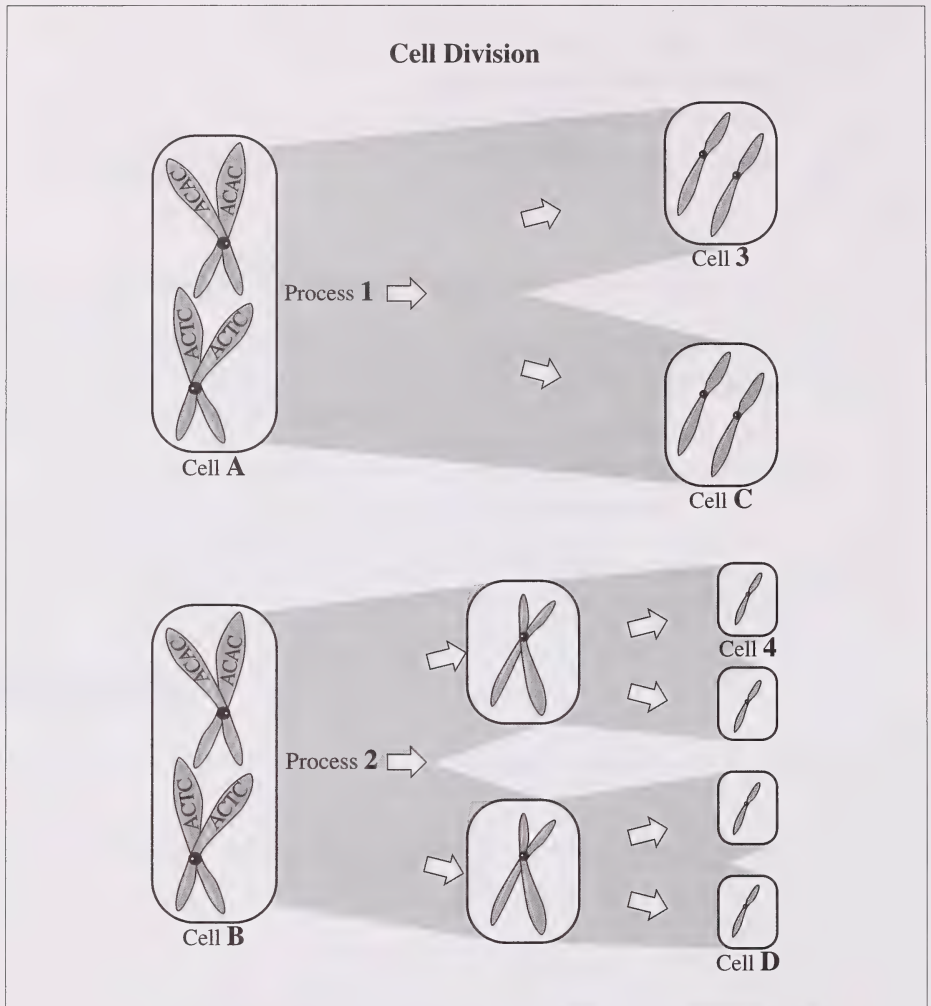
3. The events above, listed in the order in which they occur, are _____, _____, _____, and _____.

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

8. A motor neuron conducts impulses from
- A. muscles to glands
 - B. glands to muscles
 - C. the central nervous system to muscles and glands
 - D. muscles and glands to the central nervous system

9. Light rays pass through the structures of the eye in the sequence
- A. lens → cornea → pupil → retina
 - B. pupil → cornea → retina → lens
 - C. cornea → lens → pupil → retina
 - D. cornea → pupil → lens → retina
10. The human eye generates nerve impulses in response to wavelengths that range from
- A. 10 to 50 nm
 - B. 400 to 700 nm
 - C. 2 000 to 4 000 nm
 - D. 20 000 to 50 000 nm

Use the following information to answer the next three questions.



11. The cells above that would contain both sets of genetic information (ACAC and ACTC) are
- A. cell 3 and cell 4
 - B. cell 3 and cell C
 - C. cell 4 and cell D
 - D. cell C and cell D

12. In the cell division diagram, the type of cell represented by cell 3 is

- A. a zygote
- B. an egg cell
- C. a body cell
- D. a sperm cell

Numerical Response

4. Match each of the numbered processes and cells in the cell division diagram with the term below that describes it. Use each number only once.

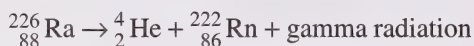
Mitosis	_____	(Record in the first column)
Meiosis	_____	(Record in the second column)
Haploid	_____	(Record in the third column)
Diploid	_____	(Record in the fourth column)

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

13. DNA can be described as
- A. an expression of a trait
 - B. a strand of protein that attacks foreign antigens
 - C. a sequence of bases on a sugar-phosphate backbone
 - D. a single stranded unit composed of sugar, phosphate, and a base

Use the following information to answer the next two questions.

The radiation that is sometimes used to treat cancer may be provided by radium-226 undergoing alpha-decay according to the equation



Numerical Response

5. What is the amount of energy released when one mole of radium-226 decays to form radon-222?

Answer: _____ $\times 10^{11}$ J/mol

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

14. A fusion reaction **differs** from a fission reaction in that a fusion reaction involves
- A. large atomic nuclei splitting to form smaller atomic nuclei
 - B. smaller atomic nuclei combining to form larger atomic nuclei
 - C. the release of energy, whereas fission involves the absorption of energy
 - D. the absorption of energy, whereas fission involves the release of energy

Use the following information to answer the next question.

Electromagnetic radiation has many applications inside and outside of the medical field.

Electromagnetic Waves

- 1** Infrared
- 2** Radio
- 3** Gamma
- 4** Visible light

Numerical Response

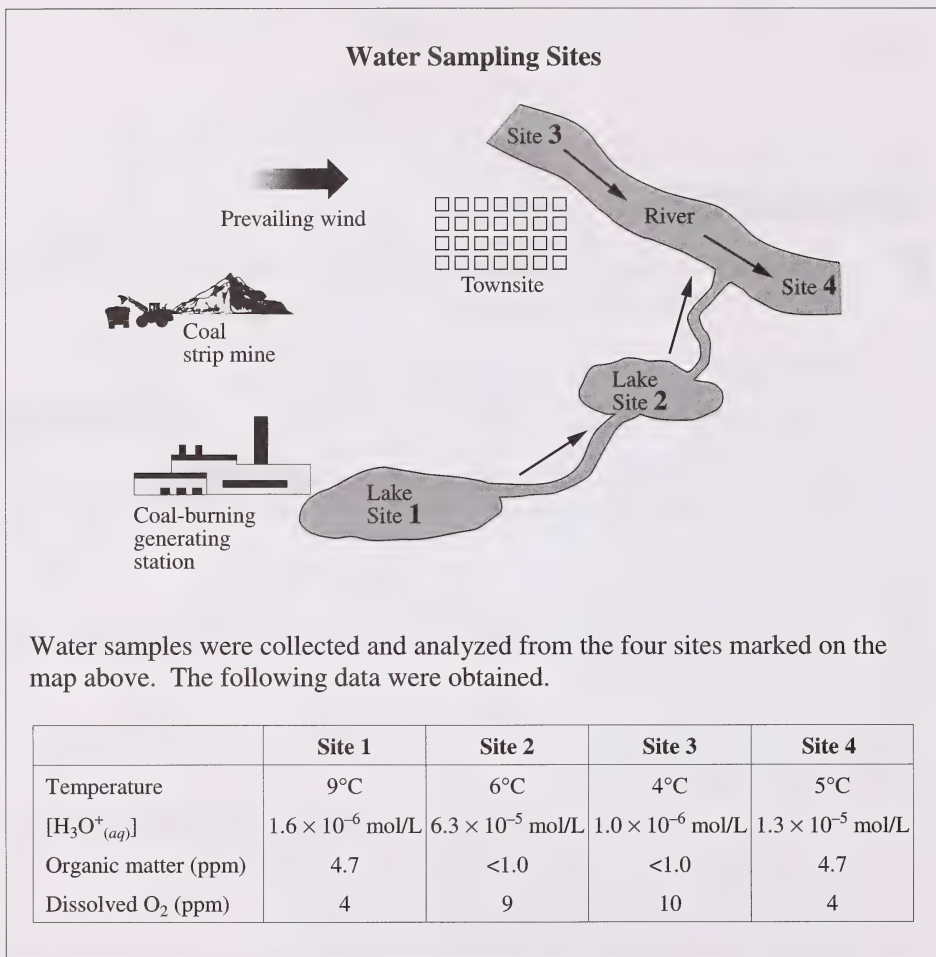
- 6.** Match each of the electromagnetic waves numbered above with its most common use, as given below. Use each number only once.

Cancer treatment	_____	(Record in the first column)
Communication	_____	(Record in the second column)
To see objects	_____	(Record in the third column)
To warm food	_____	(Record in the fourth column)

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Environmental technicians collect and analyze air, water, and soil samples.

Use the following information to answer the next two questions.



Numerical Response

7. The four test sites, listed in order from **most** acidic to **least** acidic, are _____, _____, _____, and _____.
most **least**
acidic **acidic**

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

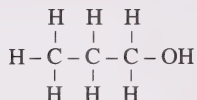
15. Fish that require a high level of dissolved oxygen would likely thrive at
- A. site 1
 - B. site 2
 - C. site 3
 - D. site 4
-
16. If a substance has a basic pH, then the pH for that substance is
- A. less than 7 and will turn red litmus blue
 - B. less than 7 and will turn blue litmus red
 - C. greater than 7 and will turn red litmus blue
 - D. greater than 7 and will turn blue litmus red
17. Fish-eating birds in a test area were found to have a higher concentration of dioxins than the fish they eat. This is a result of
- A. biodiversity
 - B. biofeedback
 - C. bioselectivity
 - D. biomagnification
18. Farmers in an area want to try a new pesticide that contains a chemical called ivermectin. This compound is similar to DDT in that it is a very stable compound and does not dissolve easily in water. Those who oppose the use of ivermectin are concerned that ivermectin will
- A. be target specific
 - B. be excreted by target organisms
 - C. biodegrade too quickly to be effective
 - D. accumulate in increasing concentrations in the food chain

Use the following information to answer the next question.

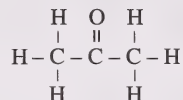
A technician tests the environment for different organic compounds.

Structural Formulas of Four Organic Compounds

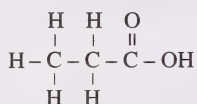
I



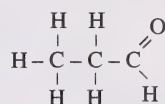
II



III



IV



19. Which of the structural formulas above represents an alcohol?
- A. Compound I
 - B. Compound II
 - C. Compound III
 - D. Compound IV

Use the following information to answer the next question.

Genetic Engineering Used to Control Weeds

Weeds may dramatically reduce food crop yields. One solution is to plant seeds that have been genetically engineered to have resistance to herbicides. After the crop is planted, herbicides can be applied to wipe out the weeds in the crop.

Short Answer—5%

Outline the risks and benefits that may be associated with using this method of weed control. You may use paragraph format, point-form notes, and/or tables in your answer.

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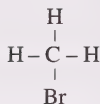
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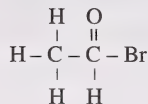
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20. Bromomethane, used in some pesticides, is being phased out over time. It is capable of breaking down large amounts of ozone in the upper atmosphere. The structural formula for bromomethane is

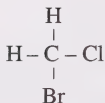
A.



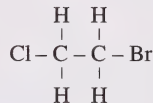
B.



C.



D.



21. The type of radiation that is absorbed by ozone in the upper atmosphere is

- A. X-ray radiation
- B. infrared radiation
- C. ultraviolet radiation
- D. gamma ray radiation

22. Depletion of the ozone layer can lead to an increase in the occurrence of cataracts. Cataracts cause vision problems by blocking some of the light that passes through the eye. Cataracts are located in the

- A. lens
- B. rods
- C. cones
- D. retina

Use the following information to answer the next question.

**Test Results of Four Soil Samples Analyzed by an
Environmental Testing Laboratory**

Sample	Pesticides mg/kg	Lead mg/kg	PCBs mg/kg	Gasoline mg/kg
1	0.05	600	0.02	20
2	0.03	10	9.00	70
3	0.01	30	0.01	800
4	20.00	40	0.04	10
Acceptable Levels	0.10	50	0.10	100

Numerical Response

9. Match each of the samples numbered above with the site of its probable pollution source, as listed below. Use each number only once.

Petroleum refinery	_____	(Record in the first column)
Farmland	_____	(Record in the second column)
Battery disposal site	_____	(Record in the third column)
Electrical equipment disposal site	_____	(Record in the fourth column)

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

In order for astronomers to explore space, they must understand the nature of electromagnetic radiation and field theory.

Use the following information to answer the next question.

Astronomers in a space station were able to observe sources of radiation from space without the interference of Earth's atmosphere. Four of their observations are listed below.

Observations

- 1** X-rays
- 2** Doppler shift
- 3** Dark-line spectra
- 4** Infrared radiation

Numerical Response

- 10.** Match each of the observations numbered above with the term below that is **most closely** associated with it. Use each number only once.

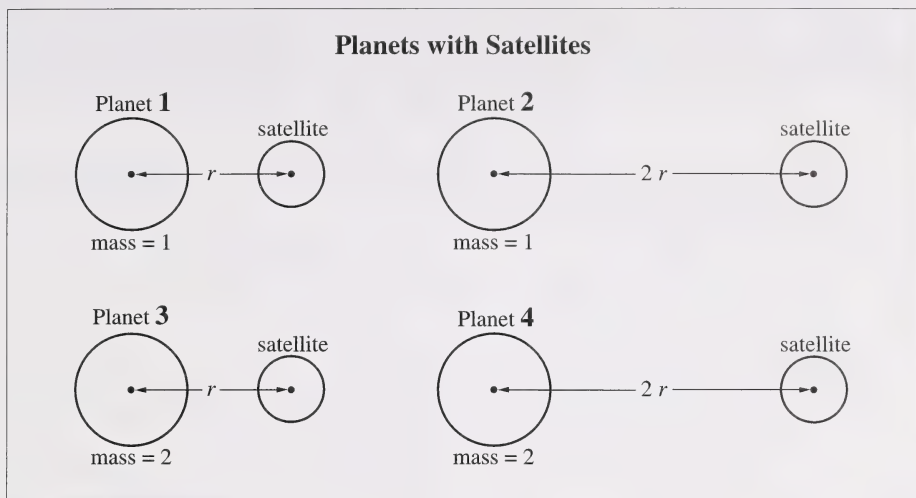
Motion of stars	_____	(Record in the first column)
Black holes	_____	(Record in the second column)
Cool star	_____	(Record in the third column)
Composition of gases around a star	_____	(Record in the fourth column)

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

- 24.** Astronomers can use red shift to calculate distance in space because the electromagnetic radiation emitted from objects moving
- A.** away from Earth is red-shifted to shorter wavelengths
 - B.** away from Earth is red-shifted to longer wavelengths
 - C.** toward Earth is red-shifted to shorter wavelengths
 - D.** toward Earth is red-shifted to longer wavelengths

25. Listed in order of **increasing** frequency, three types of electromagnetic radiation are
- A. radio waves, gamma rays, and infrared radiation
 - B. radio waves, infrared radiation, and gamma rays
 - C. gamma rays, radio waves, and infrared radiation
 - D. infrared radiation, radio waves, and gamma rays
26. Scientists are studying a type of rocket fuel that would use laser-ionized argon gas accelerated out the rear of a ship by electric fields. What electric-field strength would be produced by charged parallel plates 0.0500 m apart if the potential difference between them is 7 500 V?
- A. 5.75×10^{-7} V/m
 - B. 6.67×10^{-6} V/m
 - C. 1.50×10^5 V/m
 - D. 2.70×10^{16} V/m
27. When space science technology advances to the point that there are manned missions to Mars, a lift-off for the return flight to Earth will require more fuel than does a lunar lift-off because of the greater gravity on Mars. The mass of Mars is 6.42×10^{23} kg, and its radius is 3.38×10^6 m. The magnitude of the gravitational field at the surface of Mars is
- A. 3.75 N/kg
 - B. 1.27×10^7 N/kg
 - C. 3.75×10^{22} N/kg
 - D. 1.27×10^{29} N/kg
28. If the distance between two masses is doubled, the gravitational force (F_g) between the masses is
- A. doubled
 - B. quadrupled
 - C. reduced to one-half
 - D. reduced to one-quarter

Use the following diagrams to answer the next question.



Numerical Response

- 11.** The planets above, listed in order from the one with the **least** amount of attraction between it and its satellite to the one with the **greatest** amount of attraction are _____, _____, _____, and _____ .
least **greatest**

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

Scientists and science-literate citizens are concerned about the sources and uses of energy.

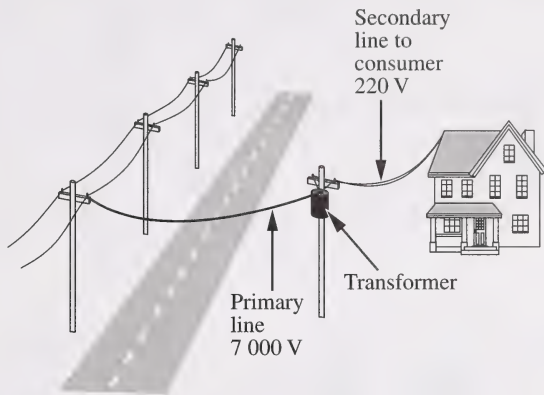
29. In a hydrogen fuel cell that uses elemental hydrogen and oxygen to produce water, the balanced equation that occurs is
- A. $2 \text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow 2 \text{H}_2\text{O}_{(l)}$
 - B. $\text{H}_{2(g)} + \text{O}_{(g)} \rightarrow 2 \text{H}_2\text{O}_{(l)}$
 - C. $\text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow \text{H}_2\text{O}_{(l)}$
 - D. $2 \text{H}_{(g)} + \text{O}_{(g)} \rightarrow \text{H}_2\text{O}_{(l)}$
30. Carbon dioxide emissions are an environmental concern because carbon dioxide
- A. traps heat, which contributes to acid deposition
 - B. traps heat, which contributes to global warming
 - C. mixes with water, which contributes to the formation of dioxins
 - D. mixes with atmospheric vapour, which contributes to ozone depletion
31. Experimental fusion reactors use deuterium and tritium fuel as their energy sources. The products of the reaction are helium-4 (alpha particle) and a neutron. This reaction can be represented by
- A. ${}_1^1\text{H} + {}_1^3\text{H} \rightarrow {}_2^4\text{He} + {}_1^1\text{n}$
 - B. ${}_1^2\text{H} + {}_1^3\text{H} \rightarrow {}_2^4\text{He} + {}_0^1\text{n}$
 - C. ${}_2^4\text{H} + {}_1^1\text{n} \rightarrow {}_1^1\text{H} + {}_1^3\text{H}$
 - D. ${}_2^4\text{H} + {}_0^1\text{n} \rightarrow {}_1^2\text{H} + {}_1^3\text{H}$

- 32.** Which of the following statements provides an accurate comparison of fusion and fission technology?
- A.** Using fission is cleaner than using fusion.
 - B.** Using fusion is less expensive than using fission.
 - C.** Fission reactions produce more energy per gram of reactant than do fusion reactions.
 - D.** A larger amount of energy is required to initiate fusion reactions than to initiate fission reactions.
- 33.** An energy source with few environmental or health risks is tidal power. Tidal energy is caused by
- A.** inertia
 - B.** solar reactions
 - C.** gravity and inertia
 - D.** solar reactions and convection

34. The rise and fall of tides around the world is mainly caused by the
- A. revolution of the sun around Earth
 - B. revolution of Earth around the moon
 - C. gravitational fields of Venus and Mars
 - D. gravitational fields of the sun and moon
35. Electrical energy from wind-powered generators is produced intermittently. It is sometimes stored in batteries to be used later. Energy **stored** in the batteries is in the form of
- A. electrical energy
 - B. chemical energy
 - C. thermal energy
 - D. kinetic energy

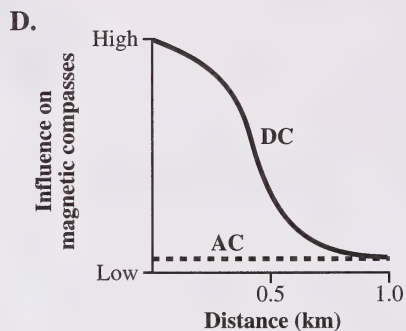
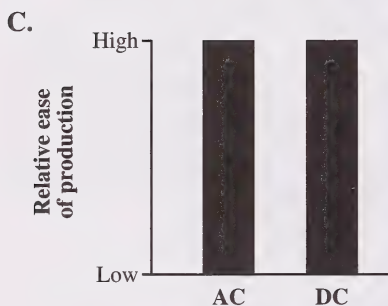
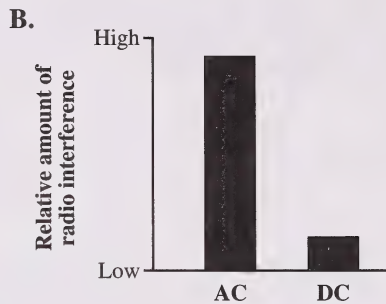
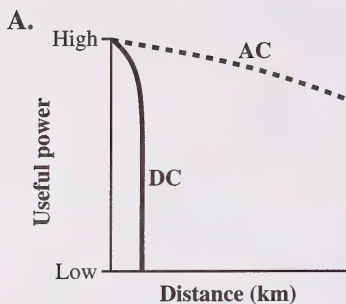
Use the following information to answer the next two questions.

A local power-transmission line supplies a primary voltage of 7 000 V to a pole transformer that steps down the voltage to 220 V in a secondary line to the consumer.



36. The ratio of the number of turns in the primary coil to the number of turns in the secondary coil of the pole transformer is approximately
- A. 7 000 : 1
 - B. 1 : 7 000
 - C. 32 : 1
 - D. 1 : 32
37. If the current in the secondary line is 10.0 A, then the power carried by the secondary line is
- A. 69.1 W
 - B. 691 W
 - C. 2.20×10^3 W
 - D. 7.00×10^4 W

38. Which of the following graphs **best** demonstrates why alternating current (AC), rather than direct current (DC), is used in long-distance energy transmission?



39. Household circuits are wired in

- A. series to increase resistance
- B. parallel to increase resistance
- C. series so that the amount of current to each appliance varies
- D. parallel so that the voltage across each appliance is consistent

Numerical Response

- 12.** A circuit in a household computer is rated at 1.50 W. If this circuit has an electrical resistance of $119\ \Omega$, then the current it draws will be _____ $\times 10^{-1}$ A.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

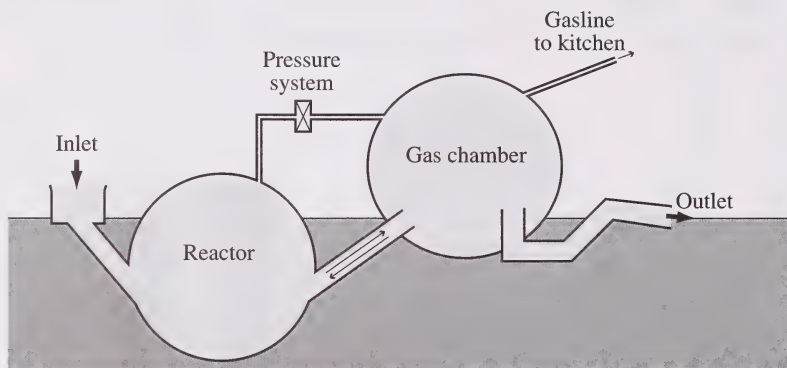
- 40.** The fuel used to heat most houses in Alberta is

- A. oil
- B. coal
- C. propane
- D. natural gas

Use the following information to answer the next question.

The use of organic waste from plants and animals could provide a significant source of energy.

One process of obtaining energy from organic waste is to use a biogas digester consisting of an airtight pit or a container lined with brick or steel. Waste matter put into this container is fermented anaerobically into methane gas, which can be collected and used as a fuel source for cooking, lighting, or generating electricity.



An alternative process is to burn manure directly. In this process, the manure is dried and then burned in furnaces.

Long Answer—15%

1. a. Hypothesize which of the two processes described above would be most efficient. Design an experiment to test your hypothesis.

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b. Explain the advantages and disadvantages of using biomass (organic waste) to produce energy on a large scale.

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Long Answer—15%

- 2.** Describe any environmental issue. Describe what steps you think society should use to deal with the environmental issue you have chosen. Include examples of political or technological strategies, where appropriate.

Note: You may **not** discuss an issue related to the use of biomass to produce energy or related to genetic engineering used to control weeds.

[illegible]

[illegible]

*You have now completed the examination.
If you have time, you may wish to check your answers.*

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